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obstacle whatever to England constructing and sending to sea, not merely those great and swift, but delicate and fragile, Atlantic hotels in which the British navy was to embark and fight, for the want of something better, but also war-ships,—real war-ships, capable of bearing the once proud flag of England boldly into the waters of any enemy whatever.

BONE-CAVES IN WALES.

FROM a careful study of the bone-caves in Wales, Dr. Henry Hicks (*Proc. geologists' association*, vol. ix. No. 1) makes some very important conclusions in regard to the contents of the caverns. The evidence shows that the area of North Wales was subjected to very great physical changes during pleistocene times. In the earliest part of the period it was raised to a considerably greater elevation than it is at present, and depressed afterwards in interglacial times to a depth of at least two thousand feet, so that it became a mere cluster of islands. After that, the area gradually rose again, with slight oscillations of level, until it attained its present configuration. Deposits relating to all these changes are to be found either on the Welsh hills or in the valleys, especially in those surrounding the Vale of Clwyd. If an attempt is made to correlate the deposits in the caverns with the glacial drifts of the neighborhood,—the results of the changes referred to,—one would be inclined to look upon the lowest drift in the caverns, that consisting mainly of local materials, as belonging to an early part of the glacial period, i.e., before the great submergence. Possibly this material was introduced into the cavern when the river flowed in the valley at a much higher level than at present, as it has much the appearance of that usually brought down by river-action. As time went on, and the valley became deepened, so that the caverns were above the reach of the floods, they probably became the abodes of hyenas and other beasts of prey, or places where animals retired to die. During the epoch of great submergence, as soon as the caverns were on a level with the sea, they were probably filled with sand, and the animal remains became entombed in them. This sand is now found in the cavities of the bones, and occasionally cemented to them. In the period of upheaval which followed, as soon as the water was again on a level with the caverns, it washed out most of the sand, and carried in with it, instead, the muddy and other materials which had been deposited in the neighborhood by floating ice. By this means there was produced a general re-arrangement of the contents of the caverns. It was as the waters receded that the upper boulder-clays were deposited both in the valleys and caverns. The abundance of bones in the caverns, and their very rare occurrence in the boulder-clays of the valleys, prove almost conclusively that they must have been accumulated in the caves, and not washed in from the boulder deposits near by. The proof furnished that the bones must have been buried in a marine sand before they were enclosed in the present cave-earth, is strong evidence

that the animals occupied the cavern in very early glacial times. Whether man also lived in the area at so early a period, cannot at present be decided by any evidence, as the flint implement found with the bones in Cae Gwyn Cave might have been introduced at a later period. It is, however, interesting to know that it appeared to be associated with the reindeer remains, and that the type is supposed to characterize what is called in France the 'reindeer period.'

AN EDIBLE CLAM INTRODUCED ON THE ATLANTIC COAST.

AN interesting shipment of shell-fish has just been received at the Wood's Holl (Mass.) station of the U. S. fish-commission. It consists of nearly eight hundred living specimens of *Tapes staminea* from the shores of Puget Sound, in Washington Territory, where it is known as the 'little round clam.' It is not unlike the quahaug (*Venus mercenaria*) in general appearance, though differently ornamented, and not growing so large, and, as in the latter species, the valves fit closely together all around when the shell is closed. This clam is one of the most highly prized of the west-coast species, of which there are several used as food. It is marketed in large quantities in all of the principal towns, and would form a valuable addition to the food-products of the Atlantic coast, if it could be made to thrive here.

The shipment was made in one of the fish-commission cars, in charge of Mr. George H. H. Moore, and was obtained at Henderson's Bay, near Tacoma, Washington Territory, where the clams live on sandy and gravelly bottoms about the level of low tide. Between four thousand and five thousand specimens were secured, and first packed in wet sand, in the large stationary tanks on both sides of the car, filling a space about twenty-four feet long by two feet wide. The sand was moistened twice a day with sea-water at a temperature of about 56° F. During the first four days not over fifty of the clams died; but at the end of that time, as they were evidently not doing well, they were taken from the sand, and kept for a few hours in pure sea-water.

Then they were transferred to a bed of sand in which the shells were laid with the ventral margin uppermost, and covered with rock-weed which was kept constantly wet. During the next two days the mortality was very great, and it was thought best to try the salt water again. They were accordingly placed in tin cans of sea-water, in which they completed the rest of the journey, arriving at Wood's Holl, Friday, June 26, about seven days from the time of leaving Tacoma, where, however, they had been kept in the tanks two or three days before starting. On the last day of the trip, over seven hundred were lost, and the exact number received at Wood's Holl was seven hundred and sixty-eight. These were transferred to a suitable sandy beach, into which many began to burrow at once. It is impossible to predict how many of those brought over will recover

from the shock of the long journey, but a number appear to be active in their new home.

In this connection it may be interesting to note that the common east-coast soft clam, *Mya arenaria*, which was introduced on the Pacific coast several years ago, has become thoroughly acclimated there, and is now very abundant.

WORK OF THE CHALLENGER EXPEDITION. — II. FROM A ZOOLOGICAL STAND-POINT.

AFTER the investigation of the physical features of the world of the sea, it was expected and has proved that the greatest additions to our knowledge would be made by the expedition in the direction of biology. From the summaries furnished by the specialists engaged on the various monographs, and printed at intervals in the text of these volumes, a few facts may be cited in the endeavor to give an approximate idea of the scope and character of the results.

The main purpose of the expedition, on the biological side, was to investigate the marine life of the sea, and incidentally to examine the life of certain isolated oceanic islands,—faunae pregnant with meaning for the naturalist, though scanty in species or individuals. Both objects were carried out in a manner satisfactory to naturalists, and creditable to the officers of the expedition. The air-breathing vertebrates, of course, were little sought after, but interesting observations are recorded on the sea-elephant and fur-seal; and the bones of cetacea dredged from the sea-bottom were sufficiently numerous and interesting to justify a special report on them by Professor Turner. The expedition seems to have needed a live harpooner, for it got no porpoises during the whole voyage, though many played about the ship. The birds collected, though not extremely numerous, were of great interest, and have been reported on by Dr. Sclater, the Marquis of Tweeddale, Dr. Finsch, Count Salvadore, Messrs. Saunders, Salvin, and Garrod. The death of the latter prevented the completion of his work on the anatomy of the petrels, which was taken up by the late W. A. Forbes, who made an exhaustive report on the subject, showing that the order of *Tubinares* must be divided, as proposed by Garrod, into two very distinct families characterized by numerous and important differences,—which indicate not only a great antiquity for the whole group, but a great amount of extinction among its past members, in the process of which nearly all

the intermediate or less specialized forms are believed to have disappeared. Professor Cunningham has reported on the marsupial mammals; Professor Parker, on the development of the green turtle; and Professor Turner, on the human crania collected during the voyage. The report on the deep-sea fishes, by Dr. Günther, is still a desideratum, but will unquestionably be of great interest. Some preliminary notes appear in this volume. A great similarity between the fish fauna of the Japan seas, the West Indies and adjacent Atlantic Ocean, and the Mediterranean, is clearly shown. At St. Paul's Rocks a new species of *Holocentrum* was found, but the fish fauna had a generally Antillean character. A remarkable fish, *Bathypterois*, was found on the coast of Brazil, with rudimentary eyes, and part of the pectoral fins modified to form extremely long tactile filaments. Another, *Ipnops*, dredged in the ocean at a depth of 1,900 fathoms, had the eyes modified to such an extent as to resemble two scale-like plates on the top of the much-flattened muzzle. No image can be formed in them, but they may serve for detecting minute quantities of light. Still another, *Echiostoma*, has eyes and formidable teeth, with long filaments extending from the chin and pectorals. A series of luminous globular bodies extends along the lower part of the body, and others of larger size are found on the head. The bones and ligaments of the deep-sea fishes are very soft, and the muscles loosely connected with each other. This is partly due to the expansion which they undergo in being raised quickly from regions where the water permeating all their bodies is under immense pressure; but the tissues must be loose to admit of such permeation, or they would be crushed and ruined under a weight which shivers solid glass to powder. Many of them are blind; many of them have phosphorescent organs, or secrete a phosphorescent slime; others have distensible stomachs and wide mouths, which engulf fishes much larger than themselves.

Turning to the division of invertebrata, we find ourselves more than embarrassed with riches. The mollusks being in the hands of Rev. Boog-Watson and Mr. E. A. Smith of the British museum, who have so far submitted only preliminary notices, we learn chiefly of some special rarities, such as the paper-thin volute, *Guivillea*, from the depths of the Southern Ocean, or the beautiful *Pecten Watsoni*, of the section *Amussium*. Mr. Smith reports, in harmony with the results of the Blake expedition, that among the bivalves dredged from a depth of over 2,000 fathoms